

I claim:

1. A tactile feedback apparatus for a cursor control device comprising:
a cursor control mechanism;
a piezo-electric material mounted on a semi-rigid substrate;
5 the substrate coupled to the cursor control mechanism; and
a control circuit electrically interconnected to the piezo-electric material for providing a signal to cause the piezo-electric material to vibrate.

2. The tactile feedback apparatus device of claim 1, further comprising:
10 the cursor control device providing a z-axis output signal;
the control circuit sensing the z-axis output signal and providing a control signal to cause the piezo-electric material to vibrate in response to the z-axis output signal.

3. The tactile feedback apparatus of claim 1 and wherein:
15 the semi-rigid material is a thin layer of metal.

4. The tactile feedback apparatus of claim 1 and wherein:
the semi-rigid material is an alumina material.

- 20 5. The tactile feedback apparatus of claim 1 and wherein:
the semi-rigid material comprises an additional piezo-electric wafer.

6. The tactile feedback apparatus of claim 1 and wherein:

the semi-rigid material comprises a ceramic material.

7. The tactile feedback apparatus of claim 1 and further comprising:

5 an indicating circuit for providing an indicating signal when the cursor is placed over a predefined position on a display; and

the control circuit providing the control signal to cause the piezo-electric material to vibrate in response to the indicating signal.

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8. The tactile feedback apparatus of claim 4 and wherein

the indicating circuit for providing an indicating signal is active when the cursor is placed over an active area on the display.

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9. The tactile feedback apparatus of claim 1 and wherein the piezo-electric material comprises a plurality of layers of piezo-electric material.

10. A computer input system comprising:

a computer;

20 a cursor control device electrically interconnected to the computer;

software for determining a cursor position based upon user actuation of the cursor control device;

the cursor control device further comprising:

an x-, y-, and z-axis sensor system;

a piezo-electric material mounted to a semi-rigid material and mechanically coupled to the cursor control device;

an electrical interconnection between the computer and the piezo-electric material, the

5 piezo-electric material being formed to vibrate upon activation by a predefined electrical signal;

the piezo-electric material providing tactile feedback to the user when activated by the predefined electrical signal.

10 11. The computer input system of claim 6 and further comprising:
the predefined electrical signal is an ac signal.

12. The computer input system of claim 7 and wherein
the ac signal is at least 20 volts peak to peak with a frequency of at least 300 Hz.

15 13. The computer of claim 6 and wherein:
The software determines a condition requiring tactile feedback and provides the electrical signal to the piezo-electric material in the cursor control device.

20 14. The computer of claim 6 and wherein:
The cursor control device includes an electric circuit for generating the predetermined signal to activate the piezo-electric material.

15. The computer input system of claim 6 and wherein the cursor control device is a pointing stick.

16. The computer input system of claim 6 and wherein the cursor control device is a
5 mouse.

17. A pointing stick for use as a cursor control device comprising:

a shaft accessible to the user for providing a physical input for cursor control;
at least one sensor mounted on the shaft for sensing the physical input applied by the

10 user;

a piezo-electric assembly including piezo-electric material mounted to a semi-rigid material;

an electrical interconnection to the piezo-electric material for providing a driving signal to the piezo-electric material;

15 the piezo-electric assembly being mechanically coupled to the pointing stick to couple vibrations from the piezo-electric assembly to the pointing stick.

18. A tactile feedback for a cursor control device comprising:

a user-actuated linkage for providing a desired cursor movement;

a piezo-electric assembly operable as a source of vibrations; and

a control device for sensing a predefined condition and providing an electrical signal to

5 activate the piezo-electric assembly; and wherein the piezo-electric assembly is

mechanically coupled to the user-actuated linkage to deliver the vibrations to the user.

19. A method for providing a tactile feedback comprising the following steps:

providing a cursor control device;

10 providing a piezo-electric assembly that vibrates upon electrical activation;

mounting the material to the cursor control device to provide a mechanical transfer of vibrations from the material to the cursor control device;

sensing a predefined condition for which tactile feedback is desired; and

activating the piezo-electric assembly to provide mechanical vibrations to the cursor 15 control device.